



Cosmic Connections: Bridging Classroom and Afterschool STEM Learning with Astronomy

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Disclaimer



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Introductions


- Sara Mitchell
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- And you?



Our Three Goals Today



1. To give you ideas for how to complement STEM concepts learned in the K-12 classroom with hands-on out-of-school time astronomy activities
2. To introduce you to NASA curriculum support materials designed for use in out-of-school time
3. To walk you through hands-on STEM activities you can immediately use in your programming



“[Science] is more than a school subject, or the periodic table, or the properties of waves. It is an approach to the world, a critical way to understand and explore and engage with the world, and then have the capacity to change that world...

— President Barack Obama, March 23, 2015

Astronomy is a Gateway to STEM

- Astronomy is often treated as an “elective” subject, but represents the overlap of many different STEM fields – math, physics, chemistry, engineering, biology, and more
- People of all ages are interested in astronomy
- A variety of resources are available for educators



STEM in Out-of-School Time



- Out-of-school time (OST) is an excellent venue for STEM programming, because it provides flexibility for guided exploration and open-ended inquiry
- OST programming is increasingly expected to connect to classroom standards (at some level)
- Standards can be seen as a limitation or an opportunity – depending on how you approach them

Astronomy in the Standards



- Astronomy appears in the NGSS (and the older NSES), with specific recommendations for each grade level
- Astronomy-themed standards are very limited in their scope, particularly for younger students – we'll largely focus today on middle school
- Students express significant interest in astronomical phenomena and objects that seem to lie outside the specific content standards for their grade levels
- How do we teach them what they want to learn?

The Three Dimensions of the NGSS



Disciplinary Core Ideas

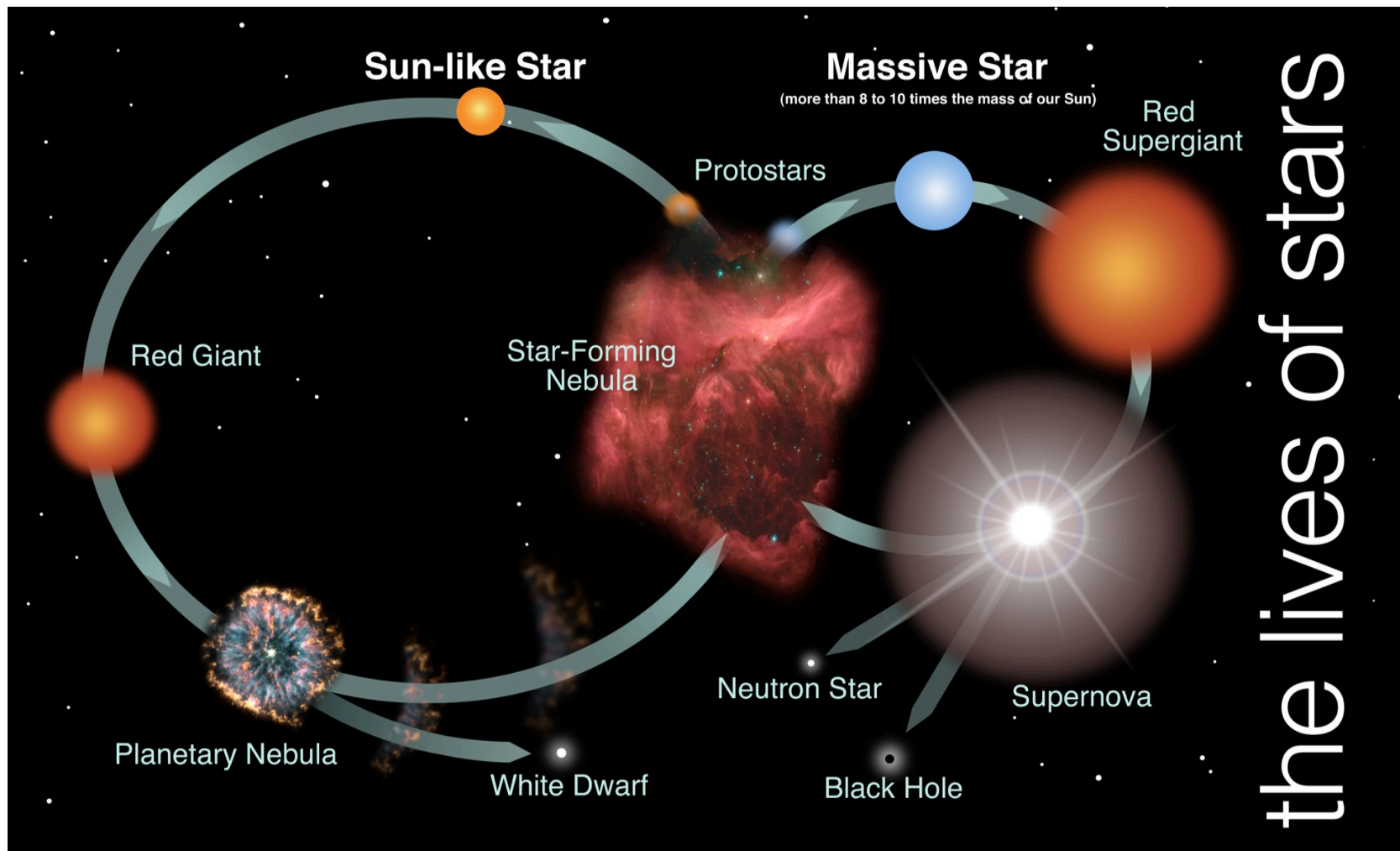


Science and Engineering Practices



Crosscutting Concepts

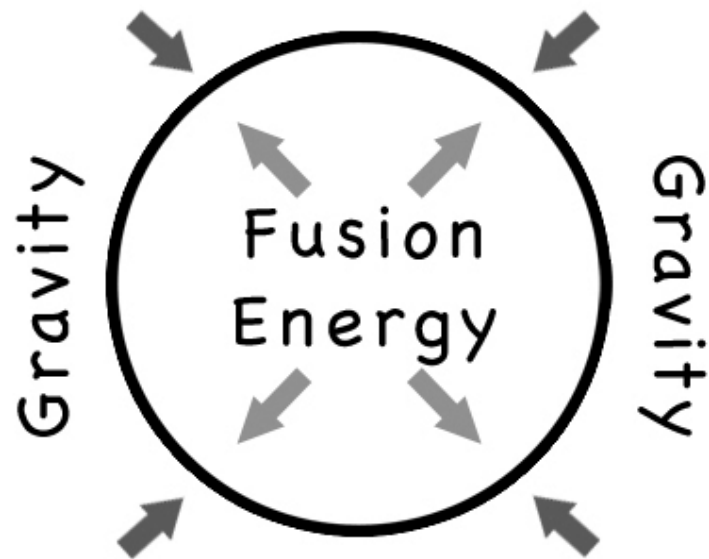
CASE STUDY: Life Cycles of Stars



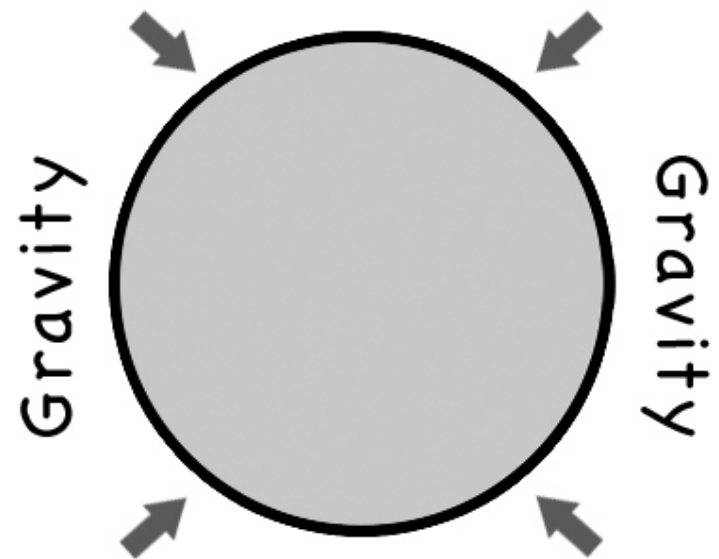
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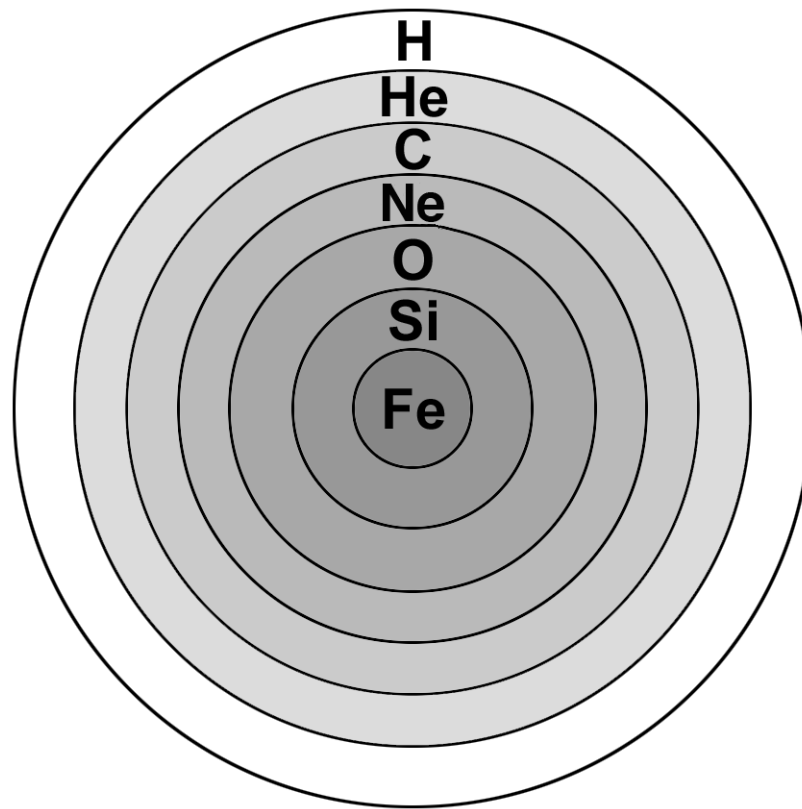


A star in equilibrium



Equilibrium lost

CASE STUDY: Life Cycles of Stars



CASE STUDY: Life Cycles of Stars

- ESS1.A: The Universe and Its Stars (grades 6-8)
 - ▣ Patterns of the apparent motion of the sun, the moon, and stars in the sky can be observed, described, predicted, and explained with models.
 - ▣ Earth and its solar system are part of the Milky Way galaxy, which is one of many galaxies in the universe.

- ESS1.B: Earth and the Solar System (grades 6-8)
 - ▣ The solar system consists of the sun and a collection of objects, including planets, their moons, and asteroids that are held in orbit around the sun by its gravitational pull on them.
 - ▣ This model of the solar system can explain eclipses of the sun and the moon. Earth's spin axis is fixed in direction over the short-term but tilted relative to its orbit around the sun. The seasons are a result of that tilt and are caused by the differential intensity of sunlight on different areas of Earth across the year.
 - ▣ The solar system appears to have formed from a disk of dust and gas, drawn together by gravity.

CASE STUDY: Life Cycles of Stars



□ Physical sciences core ideas (grades 6-8)

PS1.A: STRUCTURE AND PROPERTIES OF MATTER

How do particles combine to form the variety of matter one observes?

PS1.B: CHEMICAL REACTIONS

How do substances combine or change (react) to make new substances?

CASE STUDY: Life Cycles of Stars



- Life sciences core ideas (grades 6-8)

LS1.C: ORGANIZATION FOR MATTER AND ENERGY FLOW IN ORGANISMS

How do organisms obtain and use the matter and energy they need to live and grow?

CASE STUDY: Life Cycles of Stars



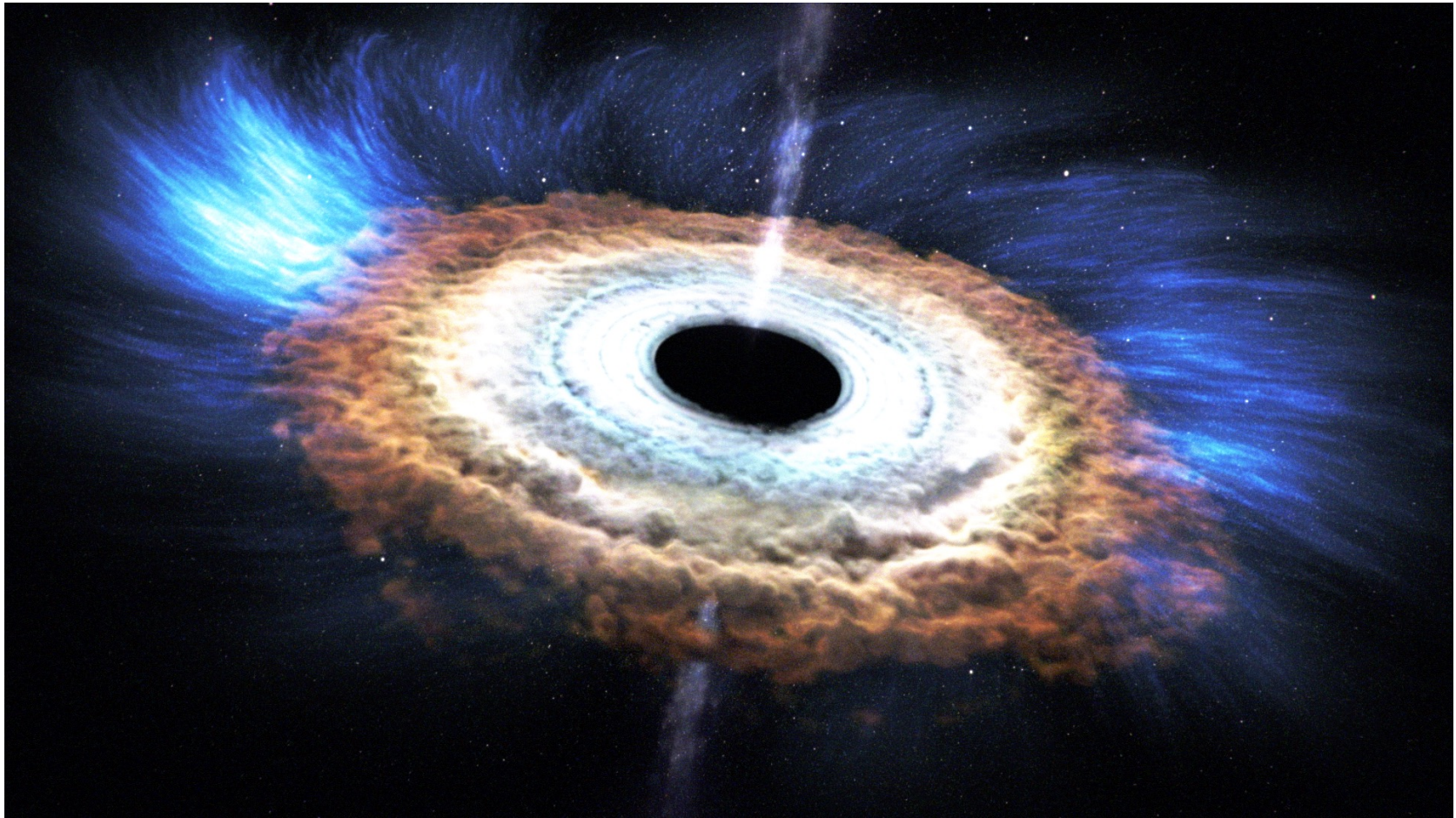
- Science and Engineering Practice 2 –
Developing and Using Models
- Crosscutting Concepts –
*Patterns, Cause and Effect, Systems and Systems Models,
Energy and Matter, Structure and Function, Stability and Change*

CASE STUDY: Life Cycles of Stars

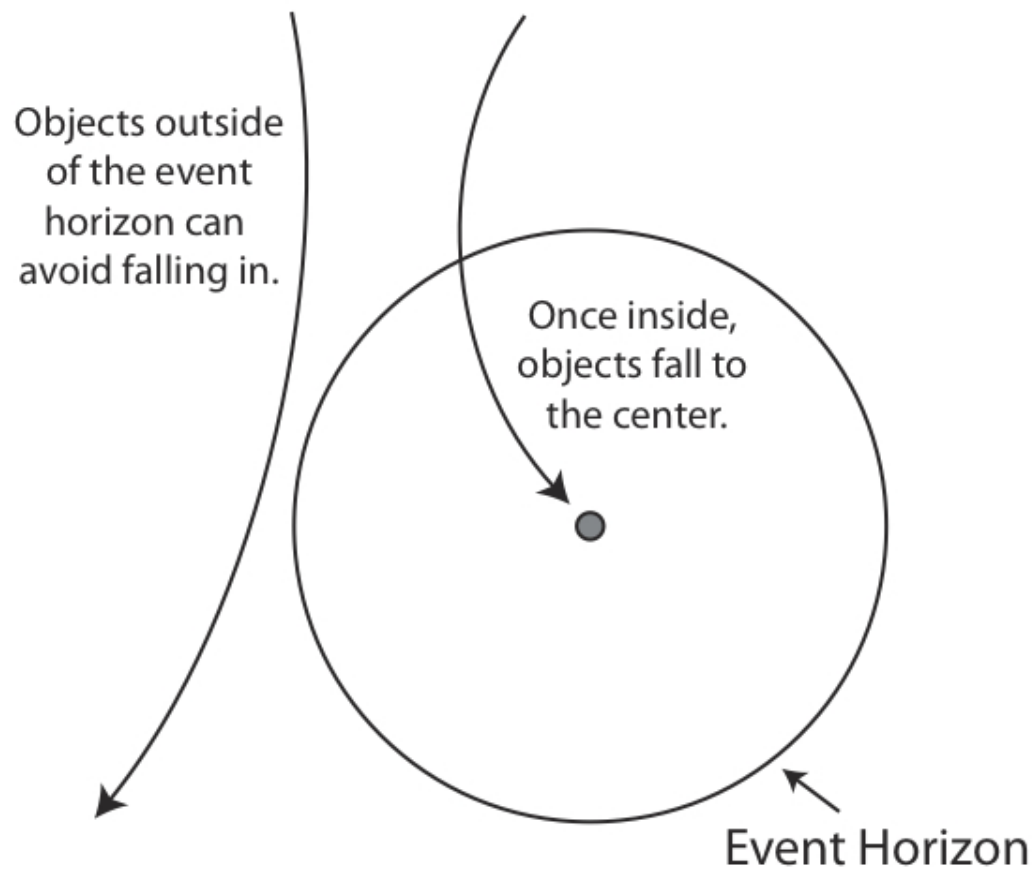
- ESS1.A: The Universe and Its Stars (grades 9-12)
 - ▣ The star called the sun is changing and will burn out over a lifespan of approximately 10 billion years.
 - ▣ Other than the hydrogen and helium formed at the time of the Big Bang, nuclear fusion within stars produces all atomic nuclei lighter than and including iron, and the process releases electromagnetic energy. Heavier elements are produced when certain massive stars achieve a supernova stage and explode.

- PS3.D: Energy in Chemical Processes and Everyday Life (grades 9-12)
 - ▣ Nuclear Fusion processes in the center of the sun release the energy that ultimately reaches Earth as radiation.

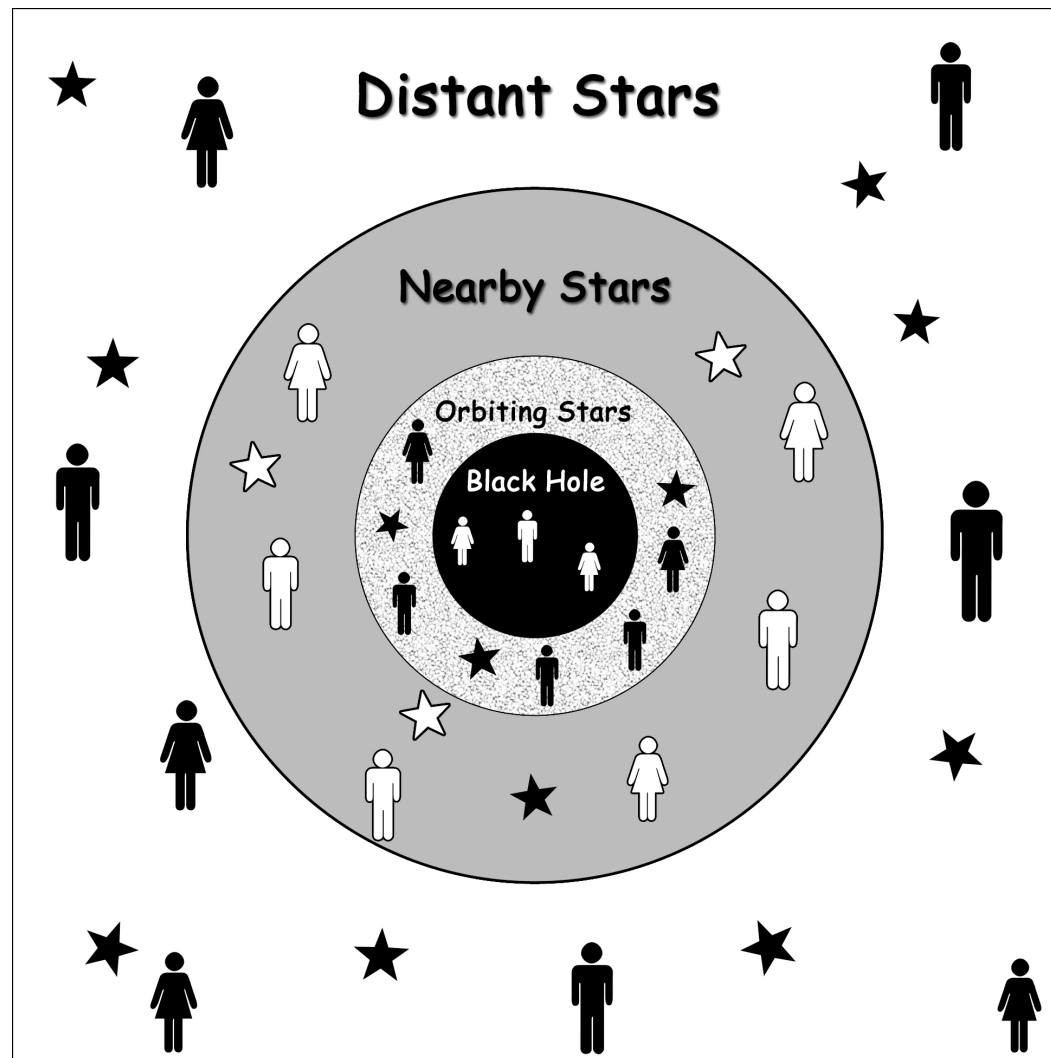
CASE STUDY: Black Holes



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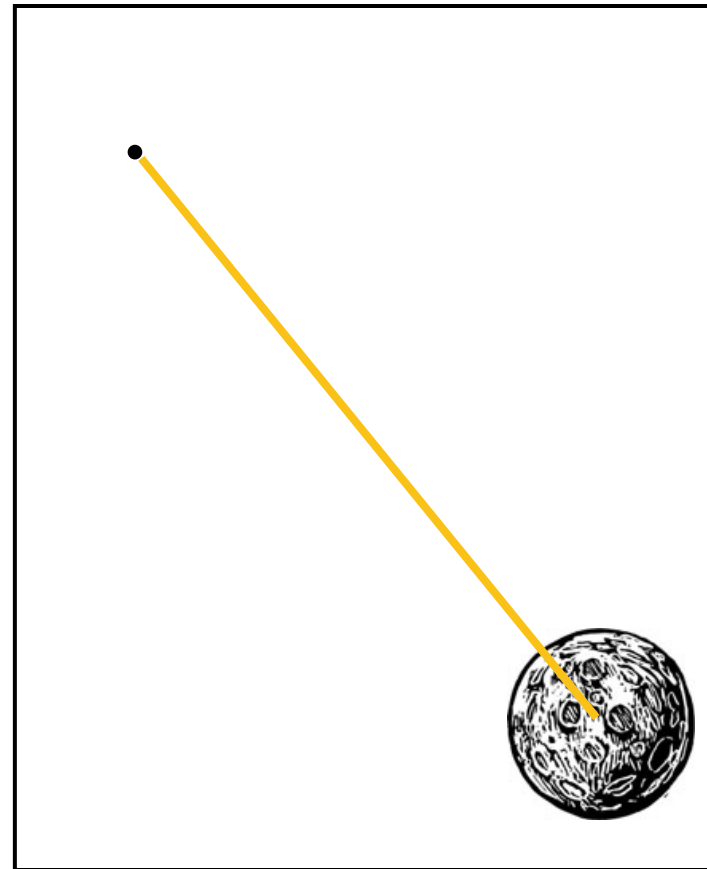
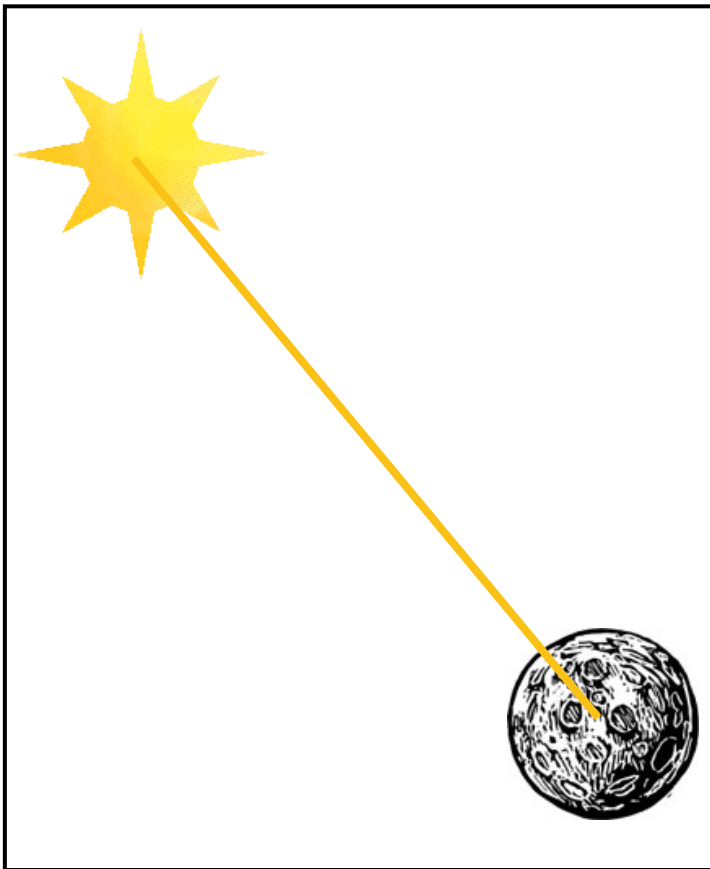


CASE STUDY: Black Holes



CASE STUDY: Black Holes

Gravity is only affected by mass!



CASE STUDY: Black Holes



- Physical sciences core ideas (grades 6-8)

PS2.A: FORCES AND MOTION

How can one predict an object's continued motion, changes in motion, or stability?

PS2.B: TYPES OF INTERACTIONS

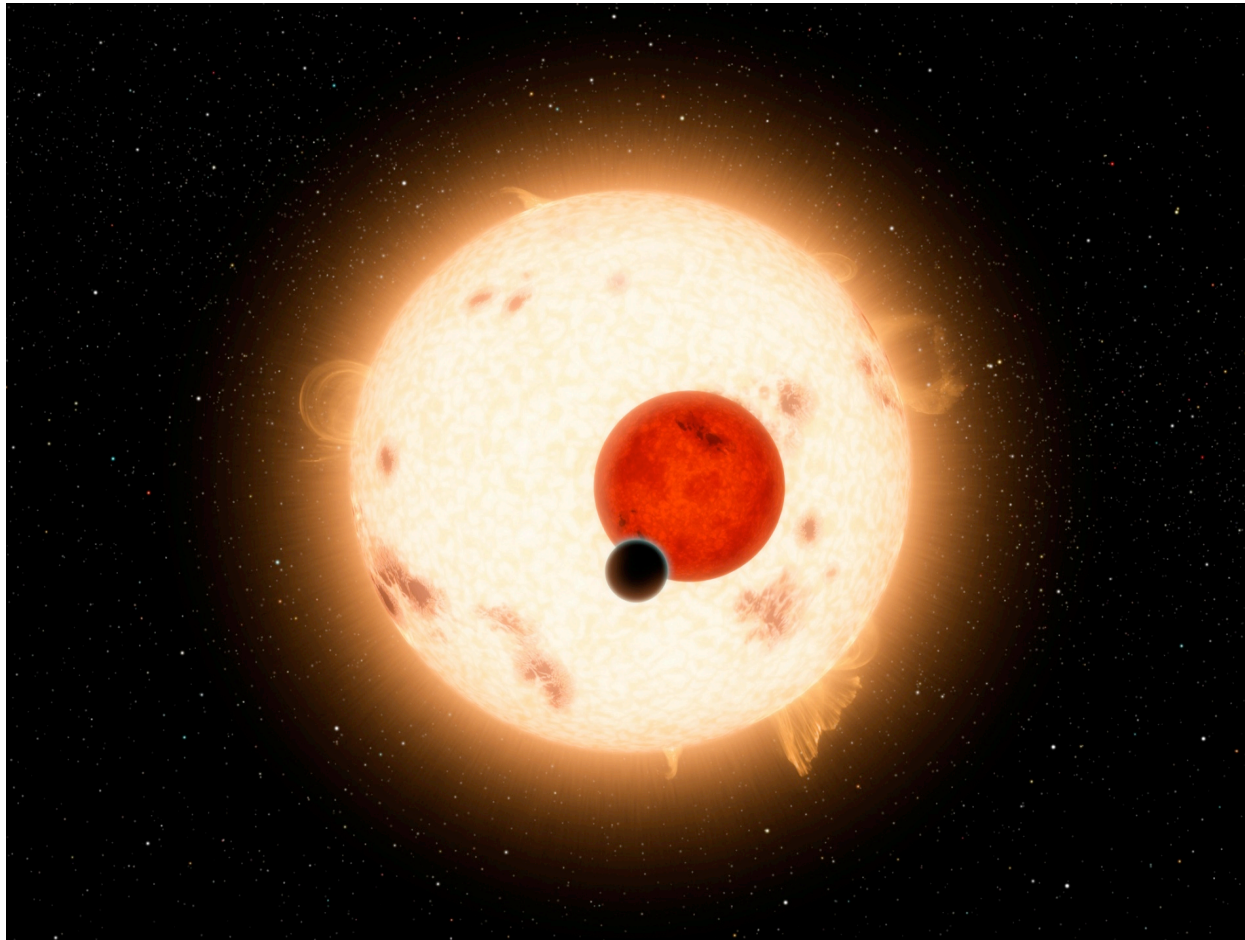
What underlying forces explain the variety of interactions observed?

CASE STUDY: Black Holes



- Science and Engineering Practice 2 –
Developing and Using Models
- Crosscutting Concepts –
Cause and Effect, Systems and Systems Models, Stability and Change

CASE STUDY: Extrasolar Planets



CASE STUDY: Extrasolar Planets

- **Activity:** Build a simple model to explore how extrasolar planets can be detected by a “wobble” in a star’s motion

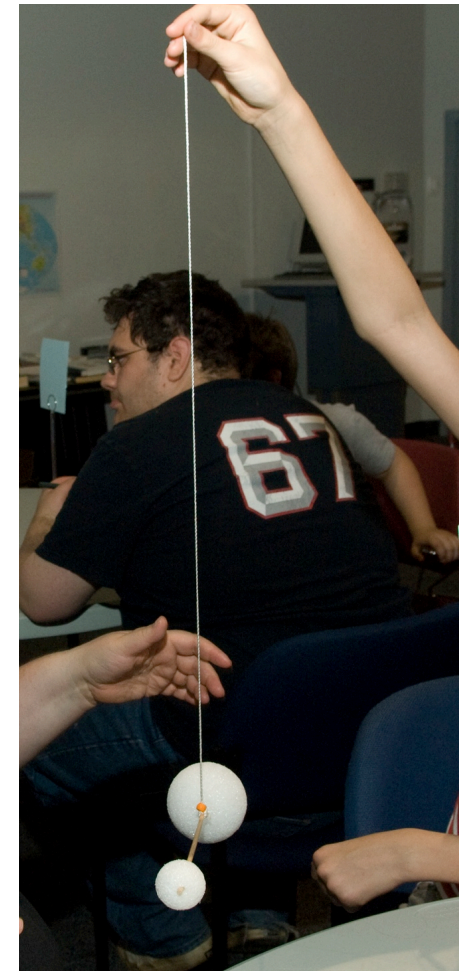
- **Possible connections:**

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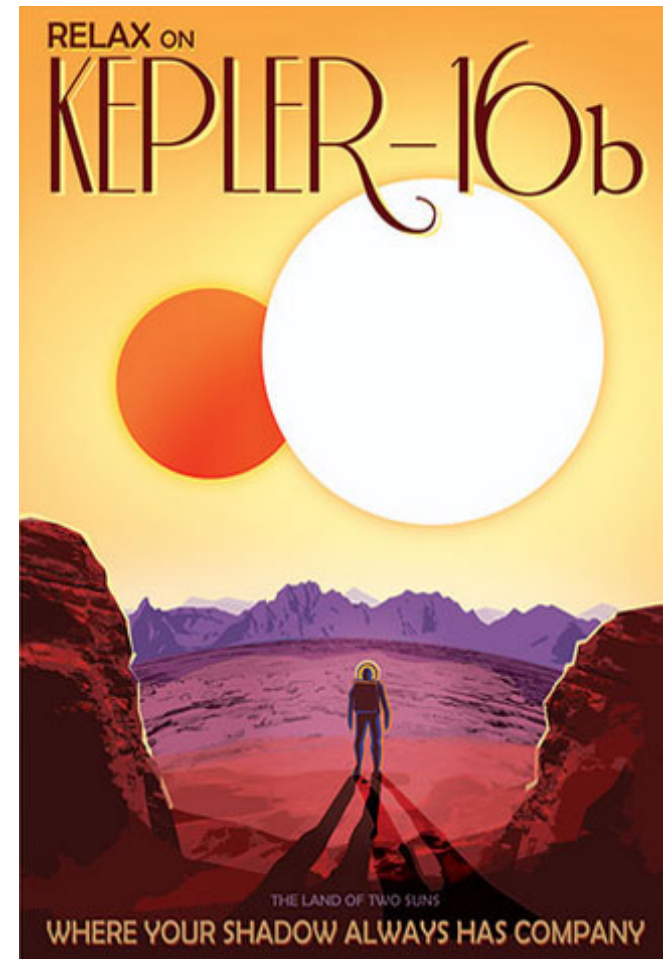
- **Activity:** Discuss the conditions and resources required by living organisms; compare to data from known extrasolar planets

- **Possible connections:**

Core Idea LS2

Ecosystems: Interactions, Energy, and Dynamics

How and why do organisms interact with their environment and what are the effects of these interactions?



Cosmic Connections... and Beyond!



- Now that we've given you a taste... we hope you'll see connections everywhere!
- Breaking down a topic or activity makes it easier to identify the core ideas it could address
- Students learn the “basics” during the school day, you can help them see the applications of what they're learning - essential for understanding, “But why should I care?”
- This approach often helps students make connections between STEM disciplines and concepts

Beyond the NGSS

- Astronomy (and other STEM fields) provide many opportunities to fulfill Common Core State Standards in Mathematics and English Language Arts/Literacy
- Incorporating opportunities to read, write, and communicate STEM content enhances critical-thinking, problem-solving, and analytical skills
- Connections to social studies, too!



Afterschool Universe

- Astronomy program for middle-school-aged children in out-of-school-time
- Current theme: the Universe beyond our Solar System – what's out there, and how astronomers study it
- Program materials, including activity videos and detailed activity instructions, are available through Afterschool Universe website



NASA Family Science Night

- Designed for middle-school students and their families to engage in STEM activities together in an enjoyable, unintimidating environment
- Session topics drawn from across NASA with connections to everyday life to make content relatable and relevant
- Activities chosen to engage participants together *as a family*



For more information...

We're going handout-free! All activities, resources, and links from this session are available at:

<http://imagine.gsfc.nasa.gov/educators/presentations/>

Or scan the QR code on your table!



Discussion



- Are there activities you've had trouble fitting into your programming?
- Are there STEM topics you've had trouble finding age-appropriate resources about for your programming?
- How can we (or your peers!) help you incorporate astronomy activities into your programming?

Wrap-up



- Comments or questions?
- Feel free to get in touch!
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 - sarah.e.eyermann@nasa.gov

Thank you for coming!